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"Signal Extraction in ARIMA Time Series"
Instructions for the User

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Program SEATS

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Instructions for the User

(Preliminary Version: September 1994)

by

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Abstract

SEATS is a program for estimation of unobserved components in univariate time series following the ARIMA–model–based method. It originated from a seasonal adjustment program developed by J.P. Burman at the Bank of England. The program fits, first, an ARIMA model, identifies the components present in the series, and derives their models. These components are typically the trend, seasonal, and irregular components, although a separate cyclical component can also be estimated. Minimum mean square error (MMSE) estimates of the components are computed, as well as their forecasts. For each component, standard errors are provided for the different types of estimators (concurrent, preliminary, and historical or final estimator) and for the forecasts. MMSE estimates of the component pseudoinnovations are also computed. The program contains a detailed diagnosis, and a detailed analysis of the revisions in the preliminary estimators, of the measurement errors in the component estimators, and of the effect of these errors on the precision of the rates of growth used in short–term monitoring. In its present form, SEATS can be used for in–depth analysis of a few series, or for routine applications to a large number of series.

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Contents

ϕ: AR
θ: MA

1 Brief Description of the Program*

SEATS ("Signal Extraction in ARIMA Time Series") is a program in Fortran for mainframes and MS DOS computers. The program falls into the class of so–called ARIMA–model–based methods for decomposing a time series into its unobserved components (i.e., for extracting from a time series its different signals). The method was originally devised for seasonal adjustment of economic time series (i.e., removal of the seasonal signal), and the basic references are Cleveland and Tiao (1976), Box, Hillmer, and Tiao (1978), Burman (1980), Hillmer and Tiao (1982), Bell and Hillmer (1984), and Maravall and Pierce (1987). These approaches are closely related to each other, and to the one followed in this program. In fact, SEATS developed from a program built by Burman for seasonal adjustment at the Bank of England (1982 version). To the Bank of England and, very specially, to J. Peter Burman for his generous help, we wish to express our gratitude.

The program starts by fitting an ARIMA model to the series. Let x_t denote the original series, (or its log transformation), and let

$$z_t = \delta(B)\, x_t, \tag{1}$$

represent the "differenced" series, where B stands for the lag operator, and $\delta(B)$ denotes the differences taken on x_t in order to (presumably) achieve stationarity. In SEATS,

$$\delta(B) = \nabla^d \, \nabla_s^D, \tag{2}$$

where $\nabla = 1 - B$, and $\nabla_s^D = (1 - B^s)^D$ represents seasonal differencing of period s. The model for the differenced series z_t can be expressed as

$$\phi(B)\, z_t = \theta(B)\, a_t + \mu, \tag{3}$$

where μ is a constant, a_t is a white–noise series of innovations, normally distributed with zero mean and variance σ_a^2, $\phi(B)$ and $\theta(B)$ are autoregressive (AR) and moving average (MA) polynomials in B, respectively, which can be expressed in multiplicative form as the product of a regular polynomial in B and a seasonal polynomial in B^s, as in

$$\begin{aligned} \phi(B) &= \phi_r(B)\, \phi_s(B^s), & (4)\\ \theta(B) &= \theta_r(B)\, \theta_s(B^s). & (5) \end{aligned}$$

Putting together (1)–(5), the complete model can be written in detailed form as

$$\phi_r(B)\, \phi_s(B^s)\, \nabla^d\, \nabla_s^D\, x_t = \theta_r(B)\, \theta_s(B^s)\, a_t + \mu, \tag{6}$$

*Thanks are due to Gianluca Caporello and Gabriele Fiorentini for their help in programming and in testing the program.

and, in concise form, as

$$\Phi(B)\, x_t = \theta(B)\, a_t + \mu, \tag{7}$$

where $\Phi(B) = \phi(B)\, \delta(B)$ represents the complete autoregressive polynomial, including all unit roots. Notice that, if p denotes the order of $\phi(B)$ and q the order of $\theta(B)$, then the order of $\Phi(B)$ is $P = p+d+D\times s$. The program SEATS requires at present that $P \geq q$.

The autoregressive polynomial $\phi(B)$ is allowed to have unit roots, which are typically estimated with considerable precision. For example, unit roots in $\phi(B)$ would be present if the series were to contain a nonstationary cyclical component, or if the series had been underdifferenced. They can also appear as nonstationary seasonal harmonics.

The program decomposes a series that follows model (7) into several components. The decomposition can be multiplicative or additive. Since the former becomes the second by taking logs, we shall use in the discussion an additive model, such as

$$x_t = \sum_i x_{it}, \tag{8}$$

where x_{it} represents a component. The components that SEATS considers are:

x_{pt} = the TREND component,
x_{st} = the SEASONAL component,
x_{ct} = the CYCLICAL component,
x_{ut} = the IRREGULAR component.

The trend component represents the long–term evolution of the series and displays a spectral peak at frequency 0. The seasonal component captures the spectral peaks at seasonal frequencies, and the cyclical component captures periodic fluctuation with period longer than a year, and will have a spectral peak for the associated frequency, between 0 and $(2\pi/s)$. Finally, the irregular component captures erratic, white-noise behavior, and hence has a flat spectrum. The components are determined and fully derived from the structure of the (aggregate) ARIMA model for the observed series, which can be directly identified from the data. The program is mostly aimed at monthly or lower frequency data. The maximum number of observations is 250. Sample sizes of that order provide good estimation results for parsimonious ARIMA models, which are unlikely to remain stable over longer periods of time.

The decomposition assumes orthogonal components, and each one will have in turn an ARIMA expression. In order to identify the components, we will require that (except for the irregular one) they be clean of noise. This is called the "canonical" property, and implies that no additive white noise can be extracted from a component that is not the irregular one. The variance of the latter is, in this way, maximized, and, on the contrary, the trend, seasonal and cycle are as stable as possible (compatible with the stochastic nature of model (7)). Although an arbitrary assumption, since any other admissible component can be expressed as the canonical one plus independent white–noise, it seems sensible to avoid contamination of the component by noise, unless there are a–priori reasons to do so. (Moreover, the component estimates for any other admissible decomposition can be obtained from the canonical ones simply by removing a constant fraction of the irregular component estimate and adding it to the trend and/or the seasonal ones.)

The model that SEATS assumes is that of a linear time series with Gaussian innovations. When this assumption is not satisfied, SEATS is designed to be used with a companion program, TRAMO ("Time Series Regression with ARIMA Noise, Missing Observations, and Outliers"), also available from us. TRAMO removes from the series special effects, identifies and removes several types of outliers, and interpolates missing observations. It also contains an automatic model identification facility. When used with TRAMO, estimation of the ARIMA model is made by the exact maximum likelihood method described in Gómez and Maravall (1994). When used by itself, SEATS contains the quasi–maximum likelihood method described in Burman (1980). In both cases, a (faster) least–squares algorithm is also available.

The program starts, thus, with estimation of the ARIMA model. The (inverse) roots of the AR and MA polynomials are always constrained to remain in or inside the unit circle. When the modulus of a root converges within a preset interval around 1 (by default (.97, 1)), the program automatically fixes the root. If it is an AR root, the modulus is made 1; if it is an MA root, it is fixed to the lower limit (.97 by default). This simple feature, we have found, makes the program very robust to over– and under–differencing.

The program produces a detailed diagnosis of the estimation results, and proceeds to decompose the ARIMA model. This is done in the frequency domain. The spectrum (or pseudospectrum) is particioned into additive spectra, associated with the different components. (These are determined, mostly, from the AR roots of the model.) The canonical condition on the trend, seasonal, and cyclical components identifies a unique decomposition, from which the ARIMA models for the components are obtained (including the component innovation variances).

For a particular realization $[x_1, x_2, \dots, x_T]$, the program yields the Minimum Mean Square Error (MMSE) estimators of the components, computed with a Wiener–Kolmogorov–type of filter applied to the finite series by extending the latter with forecasts and backcasts (see Burman, 1980). For $i = 1, \dots, T$, the estimate $\hat{x}_{it|T}$, equal to the conditional expectation $E(x_{it}|x_1, \dots, x_T)$, is obtained for all components.

When $T \to \infty$, the estimator $\hat{x}_{it|T}$ becomes the "final" or "historical" estimator, which we shall denote $\hat{x}_{it}$. (In practice, it is achieved for large enough $k = T - t$, and the program indicates how large k can be assumed to be.) For $t = T$, the concurrent estimator, $\hat{x}_{iT|T}$, is obtained, i.e., the estimator for the last observation of the series. The final and concurrent estimators are the ones of most applied interest. When $T - k < t < T$, $\hat{x}_{it|T}$ yields a preliminary estimator, and, for $t > T$, a forecast. Besides their estimates, the program produces several years of forecasts of the components, as well as standard errors (SE) of all estimators and forecasts. For the last two and the next two years, the SE of the revision the preliminary estimator and the forecast will undergo is also provided. The program further computes MMSE estimates of the innovations in each one of the components.

The joint distributions of the (stationary transformations of the) components and of their MMSE estimators are obtained; they are characterized by the variances and auto– and cross–correlations. The comparison between the theoretical moments for the MMSE estimators and the empirical ones obtained in the application yields additional elements for diagnosis. The program also presents the filter which expresses the weights with which the different innovations a_j in the observed series contribute to the estimator $\hat{x}_{it|T}$. These weights directly provide the moving average expressions for the revisions. Next, an analysis of the estimation errors for the trend and for the seasonally adjusted series (and for the cycle, if present) is performed. Let

$$\begin{aligned} d_{it} &= x_{it} - \hat{x}_{it}, \\ d_{it|T} &= x_{it} - \hat{x}_{it|T}, \\ r_{it|T} &= \hat{x}_{it} - \hat{x}_{it|T}, \end{aligned}$$

denote the final estimation error, the preliminary estimation error, and the revision error in the preliminary estimator $\hat{x}_{it|T}$. The variances and autocorrelation functions for d_{it}, $d_{it|t}$, $r_{it|t}$ are displayed. (The autocorrelations are useful to compute the SE of the linearized rates of growth of the component estimator.) The program then shows how the variance of the revision error in the concurrent estimator $r_{it|t}$ decreases as more observations are added, and hence the time it takes in practice to converge to the final estimator. Similarly, the program computes the deterioration in precision as the forecast moves away from the concurrent estimator and, in particular, what is the expected improvement in Root MSE associated with moving from a once–a–year to a concurrent seasonal adjustment practice. Finally, the SE of the estimators of the linearized rates of growth most closely watched by analysts are presented, for the concurrent estimator of the rate and its successive revisions, both for the trend and seasonally adjusted series. All SE computed are exact given that the ARIMA model for the observed series is correct. Further details can be found in Maravall (1988, 1993) and Maravall and Gómez (1992).

Although a model–based approach, SEATS can efficiently be used as a fixed–type filter for routine application to many series. The default model is then used for all series; this is the so–called Airline Model, analysed in Box and Jenkins (1970). (When the model does not accept an admissible decomposition, it is automatically replaced by a decomposable approximation.) The Airline Model is often found appropriate for actual series, and provides very well behaved estimation filters for the components. It is given by the equation

$$\nabla \nabla_{12}\, x_t = (1+\theta_1 B)\,(1+\theta_{12} B^{12})\, a_t + c,$$

with $-1 < \theta_1 < 1$ and $-1 < \theta_{12} < 0$, and x_t is the log of the series. The implied components have models of the type

$$\begin{aligned} \nabla^2\, x_{pt} &= \theta_p(B)\, a_{pt}, \\ S\, x_{st} &= \theta_s(B)\, a_{st}, \end{aligned}$$

where $S = 1 + B + \ldots + B^{11}$, and $\theta_p(B)$ and $\theta_s(B)$ are of order 2 and 11, respectively. Compared to other fixed filters, SEATS displays an advantage: it allows for the observed series to determine 3 parameters: θ_1, related to the stability of the trend component; θ_{12}, related to the stability of the seasonal component; and σ_a^2, a measure of the overall predictability of the series. Thus, even in the fixed–filter routine–type application, the filters for the component estimators adapt to the specific structure of each series. In particular, SEATS provides a relatively fast, sensible, and reliable routine seasonal adjustment procedure.

When SEATS is used jointly with TRAMO, then routine applications to many series can use the automatic model identification facility in the latter. This procedure is markedly slower and, from our experience, we believe that a preferable procedure is to use the default model for all series, and to replace it with the automatic model identification facility only when the results are unacceptable.

Finally, the program contains a relatively complete graphics facility.

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2 Instructions for the User

2.1 Hardware Requirements

This version of SEATS is compiled with the Microway NDP Fortran386 Ver. 4.0.2 and Microsoft Fortran77 Ver. 5.0, linked with the Microway 386 Linker Ver. 4.0.2 and Microsoft Fortran77 Linker Ver. 5.0. The present release breaks the 640K barrier by utilizing the full 32–bit addressing mode available on 80386 machines; it can run only on 80386–based computers (80486) that have at least 2MB of extended memory. A release that runs with conventional memory is available (it requires at least 540KB of memory).

Executing SEATS requires the following hardware:

- an Intel 80386, 80386sx, or 80486–based IBM–compatible PC;
- for floating–point operations, a numeric coprocessor compatible with the CPU such as: 80387 or 80387sx;
- a 3.5" diskette drive;
- a hard disk with about 2MB of free space;
- at least 2MB of extended memory;
- MS–DOS V3.3 or greater;
- a video graphics adapter VGA, EGA, CGA (color video is recommended).

2.2 Installation

Insert the diskette in drive A or B and change the default drive (type "A:" or "B:"); when the prompt appears, type **INSTALL**.

The installation procedure asks you the name of directory in which SEATS will be installed; by default the directory is SEATS (in this case be sure it does not already exist).

Three subdirectories are created: SERIES, GRAPH and OUTPUT. The input files should be prepared in the SERIES subdirectory.

SEATS uses two environment variables **SLIB** and **SERIES** to find the files needed to run. The variable SLIB is the path to look for the graphics library, the variable SERIES is the path to look for the series.

By default (if you install the program on C:\SEATS) the values for these are SLIB = C:\SEATS\LIB and SERIES = C:\SEATS\SERIES, so no action is necessary.

If you specified a different directory for SEATS, you must set them as needed; put in your AUTOEXEC.BAT the following two lines:

SET SLIB = *path*\LIB
SET SERIES = *path*\SERIES

where *path* is the full path name of the directory where the program is installed.

2.3 Execution of the Program

Once in SEATS type: **INPUT**

This is a very simple usable program to prepare the input file for the main program SEATS. It shows a list of the available series (in the directory specified by variable SERIES) and, after you have selected one of them, it permits to set the values of the program parameters showing a list of all default values.

The program allows some simple facilities:

"q" to exit;

"h" to see default parameter values;

"l" to list already set parameters.

Set the parameters typing them one by one according to the following syntax:

parameter–name = parameter–value

Once all (non–default) parameter values have been set, in the next line type "end". This creates the file SERIE, containing the data and parameter values for the main program. Of course the file SERIE can be edited directly; this will typically be more convenient when minor changes are desired on an already existing SERIE file.

Having, thus, the SERIE file ready, to run the program type **SEATS**.

2.4 Output File

You can see the result of the program by editing or printing the file *serie-name*.OUT in the subdirectory OUTPUT.

Several arrays are stored in the subdirectory GRAPH, from which they can be easily retrieved. A table describing the meaning of each array is contained in the Appendix.

2.5 Graphics

Typing **GRAPH** you can see some graphics on the screen. The program selects the better graphics resolution for you (if you have any graphics adapter). Running the program, files are created in the subdirectory GRAPH, containing all relevant output arrays (used by GRAPH program), from which they can be retrieved for further use in packages such as SAS, MATLAB and GAUSS or for further numerical analysis. This version also supports direct laser–jet prints of the graphics produced. Typing the command "egalaser" from the prompt (before calling GRAPH), and calling GRAPH with the option **"-P"**, the file GRAPH.LHJ is created which can then be printed.

Different graphs (such as the series, the trend, and the seasonally adjusted series, for example) can be compared through an OVERLAY facility. Further, graphs from different runs of SEATS can be simultaneously plotted. When exiting GRAPH (after its execution), you will be asked if you wish a backup copy of the graphics. By typing Y, the graphs are copied in the appropriate subdirectories of the directory GRAPH, in the files seriesname.bk1, and seriesname.n1. (If a backup was previously made, then the files become .bk2 and .n2.) In the next execution of GRAPH, you will have the option of comparing the new and old graphics (by typing 77). The maximum number of models that can be compared is 3.

Warning: The files seriesname.bk1 and seriesname.n1 are not automatically erased at the next execution of SEATS. By typing (from \SEATS)

CLEAN,

all previous backups will be erased from the directory GRAPH.

2.6 Printing SEATS User's Manual

In the directory MANUAL you can find the file EXTMAN.EXE, a self–extracting compressed file. It contains a POSTSCRIPT copy of the SEATS user manual.

In order to print it, type "EXTMAN" from the DOS prompt; this command produces a file SEATS.PS, and then you can print it in your POSTSCRIPT printer.

2.7 Downloading SEATS Using FTP Anonymous

The PC MS–DOS programs SEATS and TRAMO are now available to anyone, on the INTERNET, without requiring a login and password. The following is one way to download the programs from Datacomm.iue.it:

Step 1: FTP 149.139.6.101 using login name as 'anonymous', password as your E–mail address. Go to the directory 'seats–tramo'. This directory contains

three files:
- extseats.exe (SEATS self–extracting compressed program)
- exttramo.exe (TRAMO self–extracting compressed program)
- readme (these instructions).

Step 2: Change the transfer type to binary in order to upload binary compressed files and retrieve the three files.

Step 3: Transfer the files on your PC.

Step 4: When on your PC, in order to install the programs, type (from DOS prompt): "EXTSEATS -d" and "EXTTRAMO -d"; the two programs will be installed in the directory SEATS and TRAMO, respectively.

3 Description of the Input Parameters

3.1 Specification of the ARIMA Model

If MQ denotes the number of observations per year, the general model considered is the multiplicative $(P, D, Q) \times (BP, BD, BQ)_{MQ}$ ARIMA model, subject to the constraints $P \leq 3$, $D \leq 3$, $Q \leq 3$, $BP \leq 1$, $BD \leq 2$, $BQ \leq 1$, and $P + D + BP \times MQ + BD \times MQ \geq Q + BQ \times MQ$.

The model can be written as

$$\phi_P(B)\, \Phi_{BP}(B^{MQ})\, (z_t - \mu) = \theta_Q(B)\, \Theta_{BQ}(B^{MQ})\, a_t,$$

where

$$z_t = \nabla^D\, \nabla^{BD}_{MQ}\, x_t,$$

and μ is the mean of the differenced series z_t. For the most general case,

$$\begin{aligned}
\nabla^D &= (1 - B)^D \\
\nabla^{BD}_{MQ} &= (1 - B^{MQ})^{BD} \\
\phi_P(B) &= 1 + PHI(1) \times B + PHI(2) \times B^2 + PHI(3) \times B^3 \\
\Phi(B^{MQ}) &= 1 + BPHI(1) \times B^{MQ} \\
\theta(B) &= 1 + TH(1) \times B + TH(2) \times B^2 + TH(3) \times B^3 \\
\Theta(B^{MQ}) &= 1 + BTH(1) \times B^{MQ}.
\end{aligned}$$

For seasonal adjustment, it is required that *BPHI(1)* < 0.

Parameter		Meaning	Default
MQ	=	Number of observations per year (12 for monthly, 6 for bimonthly, 4 for quarterly, 1 for annual, ...)	12
LAM	=	0 Logs are taken 1 Original series	0
IMEAN	=	0 No mean correction ($\mu = 0$) 1 Mean correction ($\mu \neq 0$)	1
D	=	# of regular differences	1

BD	=	# of seasonal differences	1
P	=	# of regular autoregressive terms	0
BP	=	# of seasonal autoregressive terms	0
Q	=	# of regular moving average terms	1
BQ	=	# of seasonal moving average terms	1
PHI	=	P initial estimates of the regular autoregressive parameters (not input if $INIT = 0$)	-
TH	=	Q initial estimates of the regular moving average parameters (not input if $INIT = 0$)	-
$BPHI$	=	BP initial estimates of the seasonal autoregressive parameters (not input if $INIT = 0$)	-
BTH	=	BQ initial estimates of the seasonal moving average parameters (not input if $INIT = 0$)	-

When $INIT = 1$ or 2, the input parameters are entered as $PHI(i)$; $TH(i)$; $BPHI(i)$; $BTH(i)$, as detailed above.

The default model is thus the ARIMA model

$$\nabla \nabla_{12} \log x_t = (1 + \theta_1 B)\,(1 + \theta_{12} B^{12})\, a_t + \mu,$$

the so–called Airline Model, analysed in Box and Jenkins (1970).

3.2 Estimation of the ARIMA Model

$INIT$	=	0	Starting values for parameters computed by the program	0
		1	Starting values for parameter input	
		2	Starting values for parameter input and no parameter estimation is done.	
$TYPE$	=	0	Maximum likelihood estimation	0
		1	Constrained least squares	
$MAXIT$	=	A positive integer	Number of iterations in ARIMA estimation	20

EPSIV	=	A small positive number Convergence criteria for estimation of ARIMA	10^{-3}
M	=	A positive number ($M \leq 48$) Number of ACF and PACF printed in tables	36
IQM	=	A positive number Number of autocorrelations used in computing Q–statistics	24*
SEK	=	A positive number Number of standard deviations used for the detection of outliers in residuals	3
TA	=	0 Forces the residuals to have zero mean A positive number: if the t–value of the mean of the residuals is larger than *TA*, the estimator of the constant in the model is modified	100
XL	=	When the modulus of an estimated root falls in the range (XL, 1), it is set equal to UR (see below) if root is in AR polynomial. If root is in MA polynomial, it is set equal to XL	.97
UR	=	Parameter to fix roots of AR polynomial (see XL)	1
CRMEAN	=	0 Compute mean on total # of observations 1 Compute mean on # of observations equal to the largest multiple of MQ	0

(*) The default value of IQM depends on MQ. For $MQ = 12$, $IQM = 24$; for $MQ = 2, 3, 4, 6$, $IQM = 4MQ$; for $MQ = 1$, $IQM = 8$.

3.3 Forecasts and Signal Extraction

L	=	0	ARIMA estimation only	-1
	=	A positive integer.	ARIMA estimation, plus the 1– to L–periods–ahead forecast	
	=	-1	ARIMA estimation, plus signal extraction, plus forecasting (determined by the program)	

FH	=	A positive integer Minimum number of forecast horizon for series and components when $L = -1$. When TRAMO has been used as a preadjustment program, $FH = 8$	8
$EPSPHI$	=	When $\phi_P(B)$ contains a complex root, it is allocated to trend or seasonal if its frequency differs from the trend and seasonal frequencies by less than $EPSPHI$ (measured in degrees)	5
$NOSERIE$	=	0 Usual case 1 No series is used. An ARIMA model is entered ($INIT = 2$, $PHI(1) = ,\ldots$), and the program performs the decomposition of the model and the subsequent model–based analysis	0
$NOADMISS$	=	0 When model does not accept an admissible decomposition, no approximation is made 1 When model does not accept an admissible decomposition, it is automatically replaced with a decomposable model	1

The next parameter corrects for the bias that may occur in multiplicative decomposition when the period–to–period changes are relatively large when compared to the overall mean. This bias implies an underestimation of the seasonally adjusted series and of the trend in levels, caused by the fact that geometric means underestimate arithmethic means.

$BIAS$	=	0	Parameter inactive; no correction is made	1
	=	1	A correction is made for the overall bias for the full length of the series and the forecasting period. (Only when $LAM = 0$.)	
	=	-1	A correction is made so that, for every year (including the forecasting period), the annual average of the original series equals the annual average of the seasonally adjusted series, and also (very approximately) equals the annual average of the trend. (Only when $LAM = 0$.)	

3.4 Other Parameters

OUT	=	0	Reduced output file	1
	=	1	Normal output file	
	=	2	Only a short summary is produced as output	
PG	=	0	Files for Graphs are computed	0
	=	1	Files for Graphs are not computed	
$NDEC$	=	A positive number	Controls the number of printed decimals in some of the tables	2
$NDEC1$	=	As $NDEC$, but for another set of tables		3
HS	=	A positive number	Sets the scale for the vertical axis of the spectral graphs	10
$NANNUA$	=	0	Rates of Growth are not annualized	1
	=	1	Rates of Growth are annualized	
SQG	=	0	Fourier Transform of component estimation filter (for graphs)	1
	=	1	(Squared) Gain of component estimation filter (for graphs)	

3.5 Several Series / Several Models

$ITER$	=	0	One series, one model (the usual input file)	0
	=	1	several models are provided by the user to be applied by the program to the same series	
	=	2	Several series are to be treated by the program with the same model	
	=	3	Several series, each with its own specified model, are treated by the program:	

When $ITER = 1$ the names of the output file are $MODEL1.OUT, \ldots,$ $MODELn.OUT$, where n is the number of models (if $ITER = 2, 3$ the usual *seriename.OUT*).

The structure of the input file $SERIE$ if $ITER > 0$ is the following:

$ITER$	=	1	You have to append (in any format) at the end of the usual input file the number of namelist $INPUT$ that you want; remember that the structure of namelist $INPUT$ is the following: **& INPUT** *parameter–name=parameter–value, ...,* *parameter–name=parameter–value, /*
$ITER$	=	2	You have to append (in any format) at the end of the usual input file the number of series that you want, according to the following convention: *1st line:* title *2nd line:* number of observations starting year starting period frequency (# of observations/year) *3rd* to n^{th} *line:* observations in any format
$ITER$	=	3	You have to append (in any format) at the end of the usual input file the number of pairs series–namelist that you want; the convention for the series is the same as in $ITER = 2$, and for the namelist the same as in the case $ITER = 1$

When many series are to be decomposed and interest centers in estimates of the components, use $OUT = 2$. With $ITER \neq 0$, the files for graph are not computed.

When $ITER \neq 0$, SEATS puts the output in the directory $OUTPUT$. For every iteration it creates the following files:

if $ITER = 1$	*model#.out*	standard output;
	model#.tre	estimated trend component;
	model#.cyc	estimated cyclical component;
	model#.sa	estimated seasonally adjusted series;
if $ITER = 2$, or $ITER = 3$		
	title.out	standard output;
	title.tre	estimated trend component;
	title.cyc	estimated cyclical component;
	title.sa	estimated seasonally adjusted series.

When TRAMO has been used prior to SEATS as a preadjustment program, the file model#.pre (in the case $ITER = 1$) or the file title.pre (in the case $ITER = 2, 3$) are also contained in the directory OUTPUT; they consist of the series of preadjustment factors ($LAM = 0$), or components ($LAM = 1$), passed from TRAMO to SEATS.

Warning: When $ITER \neq 0$, the program $INPUT$ should not be executed. The input file is entered directly in "$SERIE$", and then SEATS can be run.

4 Input File and Examples

The input starts with the series to be modelled, comprising no more than 250 observations, followed by one set of control parameters. To specify the set of control parameters for the series model, the NAMELIST facility is used, so that only those parameters which are not at their default values need to be set.

The series is set up as:

Card 1	TITLE (no more than 72 characters)
Card 2	NZ NYER NPER NFREQ (free format)
Card 3 et seq	Z(I): I = 1, NZ (free format),

where NZ is the number of observations, NYER the start year, NPER the start period, and NFREQ is an instruction to control table format (the number of columns). Z($\cdot$) is the array of observations. (The first nonblank characters of TITLE are used by the program to create a file named ********.OUT in the subdirectory OUTPUT containing the output of the program.)

This is followed by namelist INPUT. The namelist starts with & INPUT (in the second column) and terminates with /.

Four examples of input files are provided. All are based on Spanish series.

Example 1: Consumer Price Index.

Two input files are presented. The first one applies the model

$$\nabla \nabla_{12} \log x_t = (1 + \theta_{12} B^{12})\, a_t + \mu$$

to the monthly series of the consumer price index IPC. (Notice that the standard errors of the rates of growth are not to be annualized.) The second file applies the default model to the seasonally adjusted series obtained from the previous example. It illustrates the **idempotency** properties of the default filter of SEATS. Figure 1 shows how seasonal adjustment of the seasonally adjusted series reproduces the seasonally adjusted series, and the seasonal factors obtained are, to all effects, all equal to 1.

Example 2: Monetary Aggregate.

Two models are estimated for the monthly series of the monetary aggregate ALP. The first model is the default one, and the second model is given by

$$\nabla^2 \nabla_{12} \log x_t = (1 + \theta_1 B + \theta_2 B^2)\,(1 + \theta_{12} B^{12})\, a_t.$$

The example illustrates what was mentioned in Section 1 concerning robustness of the results with respect to **overdifferencing**. Figure 2 shows how both models yield practically identical seasonally adjusted series and seasonal factors.

Example 3: Foreign Trade Series.

The third example uses the default model on the monthly series of exports, imports, and the trade balance (measured as the ratio). The example illustrates the behavior of the default filter with respect to aggregation of series (i.e., with respect to **seasonal adjustment of composite series**). Figure 3 shows how the seasonally adjusted series and the seasonal factors for the aggregate series obtained through the disaggregate ones and through direct adjustment are very close.

Example 4: Car Registration.

The last example contains the monthly series of car registration, and its quarterly aggregate. The default model is used for the former, and its quarterly analogue

$$\nabla \nabla_4 \log x_t = (1 + \theta_1 B)(1 + \theta_4 B^4)\, a_t + \mu$$

is used for the second series. The example illustrates the **time aggregation** properties of the default filter of SEATS. Figure 4 shows how the seasonally adjusted quarterly series and associated quarterly seasonal factors obtained by aggregating the monthly values are similar to those obtained by direct adjustment of the aggregate.

EXAMPLE1

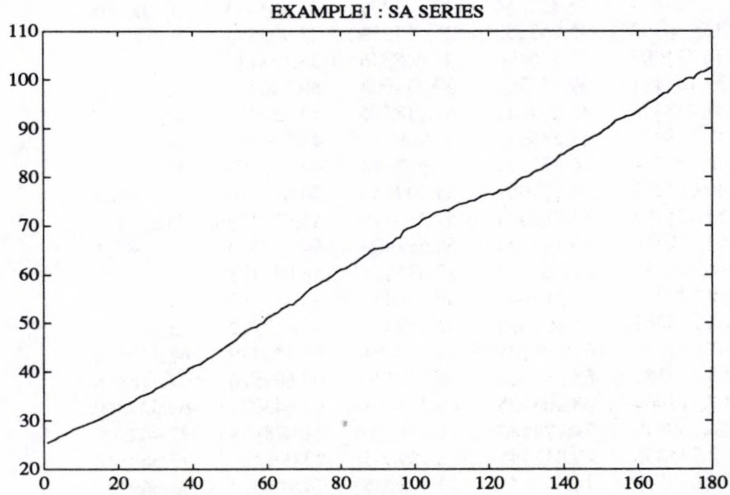
```
IPC
180 1978 1 12
 25.5449980   25.7959900   26.1269990   26.6769870   26.9439850
 27.2159880   27.8060000   28.2909850   28.5239870   28.7849880
 28.9109950   29.3029940   29.8060000   30.0369870   30.3489990
 30.8069920   31.1669920   31.4419860   32.1209870   32.4369960
 32.8639980   33.3049930   33.3849950   33.8719940   34.8039860
 35.1149900   35.3039860   35.6449890   35.8919980   36.4489900
 36.9639890   37.3969880   37.7949980   38.0979920   38.4870000
 39.0249940   39.8179930   40.0199890   40.8169860   41.2229920
 41.4149930   41.4509890   42.2629850   42.7780000   43.1179960
 43.6029970   43.9809880   44.6469880   45.5719910   45.9269870
 46.3779910   46.9879910   47.6679990   48.1259920   48.7439880
 49.0819850   49.1389920   49.6309970   49.7929990   50.9009860
 51.7609860   52.0209960   52.3369900   53.0560000   53.2759860
 53.5879970   53.7789920   54.5009920   54.9369960   55.6819920
 56.2489930   57.1219940   58.0059970   58.2269900   58.6959990
 58.9729920   59.2919920   59.7119900   60.6289980   61.0499880
 61.1739960   61.5429990   61.8589940   62.2780000   63.4379880
 63.8969880   64.2959900   64.9590000   65.1629940   65.0519870
 65.4219970   65.5199890   66.2389980   66.5799870   67.0929870
 67.3709870   69.3079990   69.6169890   69.8519900   70.0219880
 70.2169950   70.8620000   71.5699920   71.7729950   72.5159910
 72.7869870   72.6199950   72.9299930   73.4889980   73.8019870
 74.2309880   74.3989870   74.3069920   74.3249970   75.0779880
 75.0449980   75.7370000   76.1869960   76.0119930   76.2839970
 76.7679900   76.9779970   77.5359950   77.2659910   77.2619930
 77.5619960   78.5859990   79.3629910   80.0599980   80.1499940
 80.1049960   80.7419890   81.6799930   81.7379910   82.2599950
 82.4809880   82.5979920   83.0479890   84.3959960   84.5899960
 85.4849850   85.8299870   85.9689940   86.3039860   87.1439970
 87.6969910   88.0179900   88.2179870   88.2109990   88.4829860
 89.6719970   90.0649870   91.0129850   91.8209990   91.7289890
 91.9549870   93.0249940   92.8949890   93.1969910   93.3989870
 93.6639860   93.9339900   95.0999910   95.4529880   96.2329860
 96.8379970   96.9849850   97.0379940   98.5759890   99.2329860
 99.5919950   99.4849850   99.7449950   99.7259980  100.0499900
100.9619900  101.7950000  101.8559900  101.9209900  102.2269900
 &INPUT Q=0,NANNUA=0,/
```

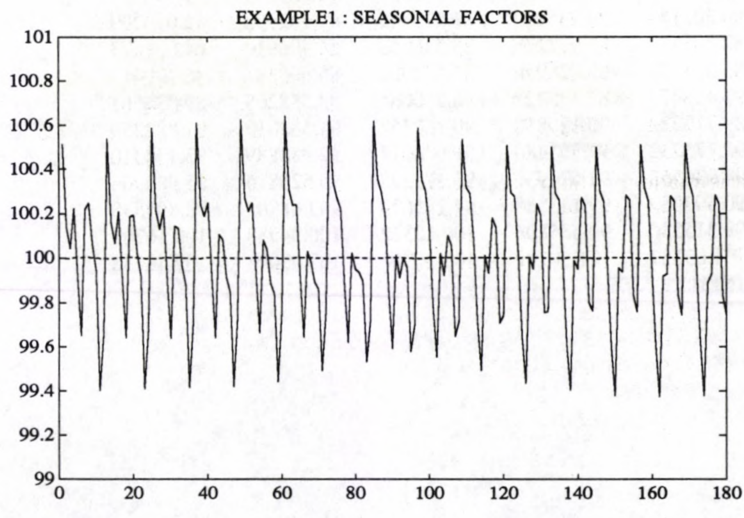
IPCSA
180 1978 1 12

25.414259	25.761105	26.115735	26.617996	26.965040
27.311301	27.745434	28.221437	28.507689	28.801040
29.084870	29.404541	29.646123	29.988956	30.328751
30.743201	31.196269	31.555145	32.061744	32.374499
32.857653	33.330664	33.583299	33.981385	34.600998
35.040593	35.258253	35.567519	35.925574	36.581213
36.911006	37.346890	37.808336	38.143135	38.712876
39.141112	39.577262	39.923908	40.740441	41.121396
41.443656	41.599941	42.218694	42.742797	43.155315
43.668488	44.236697	44.769211	45.289826	45.803918
46.280718	46.871734	47.693474	48.287856	48.705087
49.063179	49.194963	49.709648	50.071714	51.028308
51.431498	51.861944	52.213141	52.929376	53.317147
53.779310	53.763124	54.511909	54.997375	55.758735
56.535185	57.263924	57.635524	58.030128	58.538042
58.843340	59.358648	59.938853	60.615149	61.080835
61.213361	61.607073	62.149520	62.457372	63.048215
63.671117	64.106125	64.829757	65.258189	65.317282
65.414155	65.577146	66.238426	66.609576	67.376804
67.577069	68.903495	69.373184	69.643074	69.924360
70.369648	71.179580	71.555250	71.828875	72.442308
72.746896	72.877345	73.139605	73.097830	73.569848
74.016578	74.342674	74.523905	74.703814	75.069530
75.095074	75.601282	76.082917	76.234291	76.480182
76.380557	76.752858	77.322625	77.255417	77.539008
78.002069	78.585594	79.400897	79.866663	79.995883
80.301153	80.935910	81.272745	81.502903	82.046209
82.501777	82.922125	83.546063	84.406610	84.631473
85.253255	85.628986	86.141026	86.508387	86.709417
87.436472	87.795227	88.260064	88.568205	89.034661
89.712229	90.120812	90.757352	91.582015	91.882259
92.175232	92.551480	92.604017	92.958889	93.454310
94.036563	94.524930	95.177398	95.520815	95.964966
96.593089	97.143888	97.285629	98.068905	98.897638
99.315530	99.535808	100.12312	100.34933	100.16202
101.03657	101.50792	101.60950	102.09001	102.49188

&INPUT /

Figure 1: **EXAMPLE1**

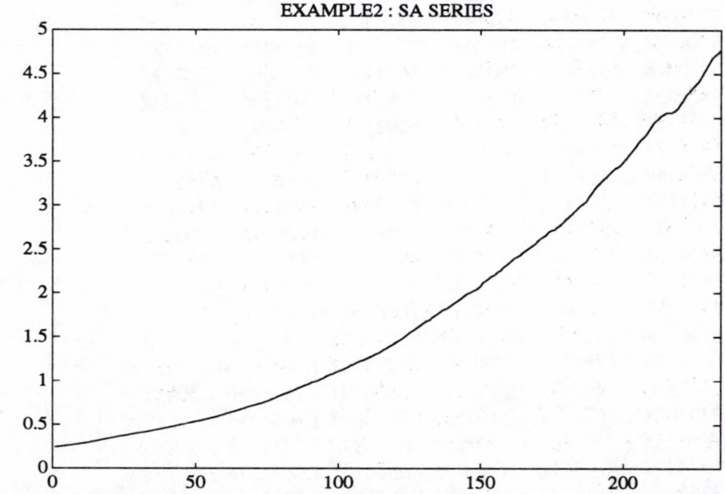


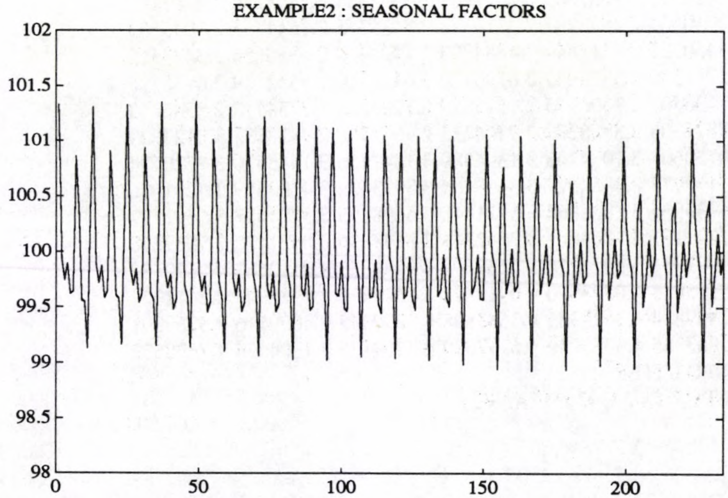


EXAMPLE2

```
ALP
     234 1972 1 12
  .2451517  .2463980  .2498829  .2544430  .2584705  .2621431
  .2690771  .2726126  .2751863  .2804869  .2843229  .2930224
  .3019492  .3042406  .3095057  .3163444  .3214716  .3286974
  .3391872  .3443586  .3480216  .3543952  .3593980  .3692598
  .3776699  .3780848  .3838493  .3911401  .3957134  .4017795
  .4120358  .4143824  .4162449  .4227730  .4277285  .4396121
  .4510856  .4497815  .4561862  .4617440  .4666080  .4747412
  .4889834  .4955763  .4993423  .5045412  .5107230  .5255544
  .5378385  .5365348  .5423381  .5491262  .5560995  .5644867
  .5806788  .5864611  .5890510  .5983202  .6055358  .6232409
  .6394368  .6387016  .6458610  .6566276  .6638200  .6746356
  .6951854  .7037723  .7087034  .7155993  .7204382  .7415145
  .7560351  .7542739  .7643105  .7788697  .7908742  .8050853
  .8339624  .8403769  .8482536  .8580419  .8641371  .8898678
  .9119159  .9135723  .9276039  .9441077  .9505333  .9657330
  .9978458  .9991560 1.0022310 1.0152789 1.0232241 1.0599459
 1.0794278 1.0745940 1.0894509 1.1095655 1.1143346 1.1291057
 1.1628859 1.1765235 1.1838329 1.1979287 1.2049063 1.2351923
 1.2527280 1.2496579 1.2650584 1.2850291 1.2976086 1.3085495
 1.3493081 1.3671929 1.3739365 1.3920073 1.4001685 1.4412989
 1.4684535 1.4675129 1.4900285 1.5206379 1.5411228 1.5587682
 1.6043311 1.6198610 1.6340096 1.6576183 1.6638014 1.6970570
 1.7356645 1.7336476 1.7562654 1.7861441 1.8019543 1.8114491
 1.8613279 1.8731371 1.8882862 1.9056718 1.9103855 1.9657455
 2.0002362 1.9904248 2.0098178 2.0314321 2.0396038 2.0677622
 2.1426534 2.1507853 2.1677969 2.1905384 2.1848266 2.2487181
 2.2740664 2.2833297 2.3114328 2.3435355 2.3644755 2.3945383
 2.4430223 2.4417847 2.4634203 2.4824270 2.4850656 2.5473352
 2.5741590 2.5828041 2.6190720 2.6429710 2.6552339 2.6958398
 2.7436405 2.7306945 2.7515689 2.7723223 2.7754717 2.8548143
 2.8871305 2.8888202 2.9264235 2.9662505 2.9878233 3.0127829
 3.0750607 3.1074703 3.1394589 3.1847256 3.1945570 3.2720194
 3.3134977 3.3054627 3.3490104 3.3933622 3.4104659 3.4291086
 3.4930904 3.5054864 3.5321348 3.5698205 3.5801417 3.6697777
 3.7221171 3.7268061 3.7642348 3.8178336 3.8521472 3.9067670
 4.0009051 3.9924814 4.0137494 4.0284333 4.0113683 4.0672533
 4.0775085 4.0573600 4.0989872 4.1647478 4.1988942 4.2611374
 4.3439884 4.3478335 4.3683898 4.3890045 4.4009616 4.5269391
 4.5863325 4.6035059 4.6747529 4.7204175 4.7304978 4.7678532
 &INPUT ITER=1,/
 &INPUT D=2,Q=2,IMEAN=0,/
```

Figure 2: **EXAMPLE2**





EXAMPLE3

```
EXP
    155 1976 1      12
  49444.0000  48682.0000  45133.0000  38067.0000  39767.0000  47488.0000
  52028.0000  41625.0000  45400.0000  44329.0000  55267.0000  76312.0000
  51291.0000  62050.0000  63352.0000  56173.0000  68656.0000  54479.0000
  60236.0000  60335.0000  61916.0000  73630.0000  71528.0000  91661.0000
  77158.0000  88518.0000  80183.0000  86899.0000  84819.0000  83798.0000
  84636.0000  70119.0000  66863.0000  80402.0000  93158.0000 105046.0000
  92036.0000 103368.0000  98925.0000  94260.0000 101168.0000 104374.0000
 103109.0000  95722.0000  77345.0000  92269.0000 119921.0000 138740.0000
  96795.0000 119534.0000 126831.0000 120935.0000 123494.0000 123797.0000
 103653.0000  96898.0000 105899.0000 133477.0000 125616.0000 216258.0000
  97572.6875 129616.0000 141593.0000 132478.0000 161804.0000 176383.0000
 212728.0000 150908.0000 126844.0000 151760.0000 175499.0000 231237.0000
 146088.0000 203651.0000 196633.0000 170473.0000 183629.0000 160610.0000
 220743.0000 130827.0000 171692.0000 168126.0000 225863.0000 279671.0000
 162446.9375 188385.0625 269524.2500 173623.1250 283792.0000 252020.3750
 234237.7500 196265.9375 228235.8125 251133.4375 292554.4375 306381.5625
 300383.0000 304328.0000 332838.0000 290566.0000 332370.0000 329840.0000
 318266.0000 238763.0000 279975.0000 339210.0000 316525.0000 348064.0000
 319779.0625 315178.0000 334498.0000 312250.0000 387798.0000 306971.0000
 373121.2500 266327.3125 280446.9375 380393.8750 366700.0000 460679.6875
 262048.0000 324444.1250 301816.2500 357067.3125 309480.2500 337888.8750
 358475.6250 202038.0000 261781.7500 360970.5000 346161.0000 378053.0000
 292547.0000 339213.0000 339605.6875 331736.0000 393349.0000 345999.0000
 403641.0000 239238.1875 347911.4375 345673.0000 398127.0000 418583.0000
 294990.0000 406433.0000 419178.0000 374945.0000 414450.0000 397143.0000
 401256.0000 259475.0000 437628.0000 374514.0000 456696.0000
 &INPUT ITER=2, /
IMP
    155 1976 1      12
  81340.0000  90740.0000  87283.0000  92280.0000 108751.0000  98371.0000
  96072.0000  97390.0000  95857.0000  93761.0000 105296.0000 123209.0000
  77842.0000 108640.0000 102936.0000 107108.0000 126357.0000 114519.0000
 103206.0000 121754.0000 122954.0000 118206.0000 122513.0000 124490.0000
 122322.0000 131534.0000 103278.0000 110231.0000 129592.0000 136299.0000
 127650.0000  96058.0000 108285.0000 126094.0000 124969.0000 115226.0000
 118058.0000 137256.0000 116264.0000 125669.0000 141187.0000 123371.0000
 159249.0000 130306.0000 138853.0000 163418.0000 171654.0000 178722.0000
 159990.0000 189853.0000 192576.0000 224908.0000 189324.0000 207563.0000
 188045.0000 152988.0000 245218.0000 208279.0000 224281.0000 267627.0000
 174331.0000 225444.0000 247724.0000 244997.0000 272892.0000 269039.0000
 258690.0000 227697.0000 206856.0000 323611.0000 231887.0000 287270.0000
 244025.0000 261139.0000 295343.0000 298748.0000 270346.0000 299403.0000
 292100.0000 228846.0000 266101.0000 238904.0000 361268.0000 409316.0000
 312048.1875 336754.2500 355977.6250 341221.2500 382700.5000 347066.5625
 329253.5000 300734.4375 286826.8750 336327.6250 394985.2500 452574.0000
```

395458.6250 380705.3750 370659.1250 340281.0000 416519.8750 364381.8750
466714.0000 298013.6250 331545.0000 444087.0000 422288.8125 398336.3750
429676.8750 404920.0000 400468.0000 436364.3750 466257.0000 414403.0000
393292.8125 345976.8125 374880.7500 437928.7500 413940.0000 555129.5625
329502.0625 374747.0625 372795.6875 416947.0625 390024.6875 459939.6875
456881.8125 279095.0000 384625.3125 512148.7500 451016.0000 463044.0000
368530.0000 495839.0000 500334.1250 503945.0000 513999.0000 484132.0000
589572.0000 371218.5000 513396.4375 601960.0000 538550.0000 548363.0000
428556.0000 559184.0000 608968.0000 576878.0000 592526.0000 607677.0000
565997.0000 482257.0000 643753.0000 624850.0000 654830.0000
EXP/IMP
155 1976 1 12
6.0786821e-01 5.3649989e-01 5.1708809e-01 4.1251625e-01 3.6567020e-01
4.8274390e-01 5.4155217e-01 4.2740528e-01 4.7362217e-01 4.7278719e-01
5.2487274e-01 6.1937034e-01 6.5891164e-01 5.7115243e-01 6.1545038e-01
5.2445196e-01 5.4334940e-01 4.7572019e-01 5.8364824e-01 4.9554840e-01
5.0357044e-01 6.2289562e-01 5.8384008e-01 7.3629207e-01 6.3077778e-01
6.7296669e-01 7.7638026e-01 7.8833540e-01 6.5450799e-01 6.1481009e-01
6.6303173e-01 7.2996523e-01 6.1747241e-01 6.3763541e-01 7.4544887e-01
9.1165188e-01 7.7958292e-01 7.5310369e-01 8.5086527e-01 7.5006565e-01
7.1655322e-01 8.4601730e-01 6.4747031e-01 7.3459396e-01 5.5702794e-01
5.6461956e-01 6.9862048e-01 7.7628943e-01 6.0500656e-01 6.2961344e-01
6.5860232e-01 5.3770875e-01 6.5228920e-01 5.9643096e-01 5.5121381e-01
6.3336994e-01 4.3185655e-01 6.4085674e-01 5.6008311e-01 8.0805748e-01
5.5969786e-01 5.7493657e-01 5.7157562e-01 5.4073315e-01 5.9292321e-01
6.5560383e-01 8.2232788e-01 6.6275796e-01 6.1319952e-01 4.6895810e-01
7.5682984e-01 8.0494657e-01 5.9865997e-01 7.7985670e-01 6.6577843e-01
5.7062474e-01 6.7923698e-01 5.3643417e-01 7.5571037e-01 5.7168139e-01
6.4521366e-01 7.0373874e-01 6.2519515e-01 6.8326428e-01 5.2058286e-01
5.5941406e-01 7.5713818e-01 5.0882858e-01 7.4155116e-01 7.2614421e-01
7.1142068e-01 6.5262209e-01 7.9572673e-01 7.4669286e-01 7.4067180e-01
6.7697562e-01 7.5958136e-01 7.9937931e-01 8.9796251e-01 8.5390016e-01
7.9796912e-01 9.0520419e-01 6.8192940e-01 8.0118149e-01 8.4445550e-01
7.6383682e-01 7.4954626e-01 8.7379416e-01 7.4423149e-01 7.7837104e-01
8.3526774e-01 7.1557171e-01 8.3172585e-01 7.4075477e-01 9.4871108e-01
7.6978370e-01 7.4809639e-01 8.6862047e-01 8.8587718e-01 8.2985976e-01
7.9528486e-01 8.6576829e-01 8.0960231e-01 8.5638525e-01 7.9348887e-01
7.3463735e-01 7.8461347e-01 7.2390405e-01 6.8061498e-01 7.0481574e-01
7.6751379e-01 8.1645157e-01 7.9382140e-01 6.8411924e-01 6.7875780e-01
6.5827819e-01 7.6527192e-01 7.1467905e-01 6.8463394e-01 6.4446731e-01
6.7766625e-01 5.7424580e-01 7.3925726e-01 7.6333195e-01 6.8833478e-01
7.2683231e-01 6.8834159e-01 6.4995545e-01 6.9946298e-01 6.5354292e-01
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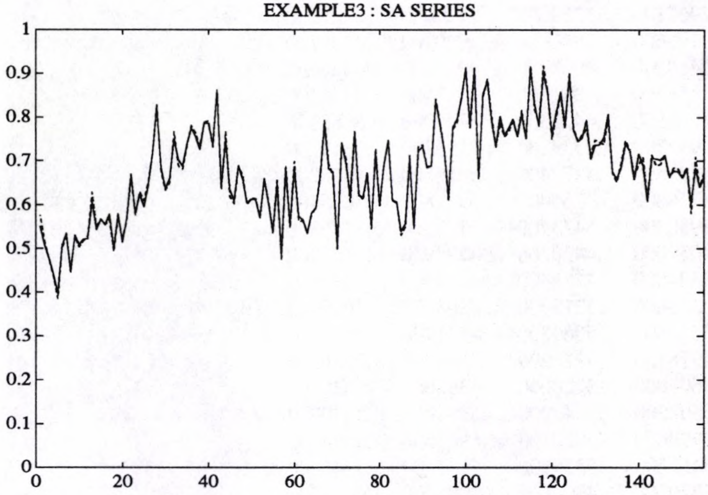
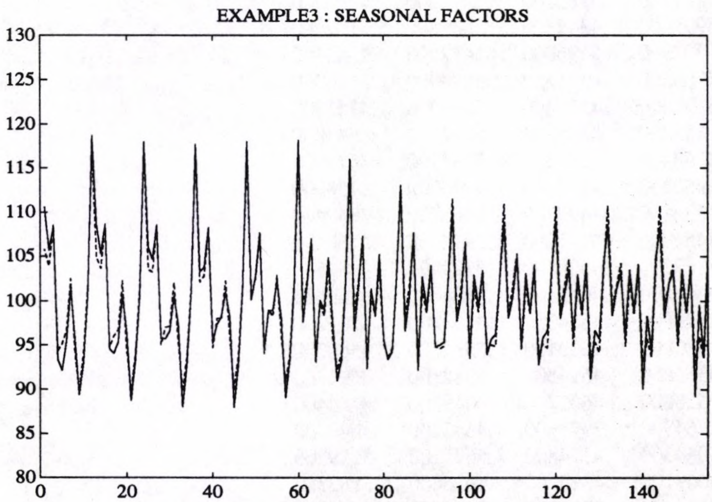
Figure 3: **EXAMPLE3**





EXAMPLE4

MATAUT

240	1971	1	12
.2883500	.3392800	.4326900	.4072800
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.2967100	.3259600	.3220400	.2986300
.3196600	.3841000	.5040700	.4121700
.4454100	.4963700	.4969800	.3427400
.3753500	.4241600	.4203400	.4456400
.5091500	.4493300	.5770900	.5063600
.4997700	.5338200	.5198100	.3361700
.4293500	.5479400	.5456500	.4973200
.4776000	.4765400	.5977800	.5025400
.4930800	.5473700	.6100300	.3765300
.4037000	.4430300	.4296900	.3993400
.4394800	.4721400	.4639400	.5148800
.4365800	.5213600	.6198100	.4059000
.3596800	.5069300	.4851700	.4960100
.4976100	.4276200	.5965000	.5836500
.5690000	.5220000	.6350600	.3025800
.4309300	.5344900	.5333000	.5640300
.4997600	.5922100	.6905500	.5955400
.6492600	.6359200	.6537700	.3746700
.4670200	.4993800	.5005900	.4699200
.5063600	.5096200	.6945600	.7280700
.6018800	.5880100	.5371600	.4141600
.4801600	.5181700	.5222600	.4399200
.5937400	.4342800	.5609800	.5167900
.6707900	.5596000	.5472200	.4383400
.4700500	.4495500	.5994900	.3656900
.3790500	.4519400	.5083300	.4751800
.5825400	.4436300	.5182100	.3547800
.4568400	.5994300	.5035700	.4679900
.3950200	.3913700	.4077500	.4758100
.4936800	.4499700	.4868700	.3049400
.3464800	.4291000	.3993300	.4768400
.4187300	.4309100	.5372900	.4487500
.4566900	.4693100	.5323600	.3069400
.3378800	.4584300	.4893200	.4707200
.4860200	.4233100	.5512100	.4500200
.5360800	.4594500	.4982100	.3696700
.3528800	.4601700	.4419000	.4754400
.4764300	.3971600	.4642200	.5040400
.5064300	.4174400	.5641200	.3619200
.3069700	.4325700	.4026600	.3883300
.4674400	.3754900	.5418500	.5164300
.4378100	.4272000	.6648900	.3339100

```
  .3292700    .5752100    .4904700    .5905500
  .2933000    .4108800    .5573200    .5238800
  .5940800    .6753700    .8271600    .4439400
  .4573400    .7129100    .6844900    .7098400
  .5951000    .6865000    .8438000    .8609500
  .8028800    .7987800   1.1054300    .5950100
  .5576400    .7869000    .7844500    .8652000
  .8101200    .8171300   1.0475600    .7591200
  .9786800   1.0241900   1.0674100    .7749300
  .6943100    .8657600    .8908900    .9621000
  .8680300    .9721500   1.0972700    .9481700
 1.0078000   1.1788300   1.1387700    .7561000
  .7258600    .9460900    .9154300    .9392300
  .8548500    .8487200   1.0581000    .9107600
  .9656300    .9394200   1.0785700    .7520800
  .5184700    .7725800    .7070200    .6637400
 &INPUT ITER=3, /
MATAUTQ
      80       1971         1      4
 1.0603200e+00 1.2684600e+00 1.0552600e+00 9.4663000e-01
 1.2078300e+00 1.3539500e+00 1.2150700e+00 1.2901400e+00
 1.5355700e+00 1.5399500e+00 1.2853300e+00 1.5909100e+00
 1.5519200e+00 1.5429900e+00 1.3902600e+00 1.2720600e+00
 1.3755600e+00 1.4728200e+00 1.3853900e+00 1.4881100e+00
 1.5217300e+00 1.6746500e+00 1.3685700e+00 1.6318200e+00
 1.7825200e+00 1.8807200e+00 1.4954600e+00 1.4698900e+00
 1.7105400e+00 1.9179600e+00 1.4314800e+00 1.4803500e+00
 1.5890000e+00 1.7471800e+00 1.4556100e+00 1.4147300e+00
 1.3393200e+00 1.5013500e+00 1.3298300e+00 1.5709900e+00
 1.1941400e+00 1.4194600e+00 1.1382900e+00 1.3052700e+00
 1.3869300e+00 1.3747500e+00 1.1771800e+00 1.4184700e+00
 1.4605400e+00 1.4455500e+00 1.2207600e+00 1.3775100e+00
 1.3378100e+00 1.4279100e+00 1.2330100e+00 1.2235600e+00
 1.3847800e+00 1.3814400e+00 1.3280700e+00 1.6562300e+00
 1.2615000e+00 1.7933300e+00 1.7284400e+00 2.1072400e+00
 2.1254000e+00 2.4626100e+00 2.2580800e+00 2.4365500e+00
 2.6748100e+00 2.7619900e+00 2.5366500e+00 2.7187500e+00
 2.9374500e+00 3.1348000e+00 2.6207300e+00 2.8007500e+00
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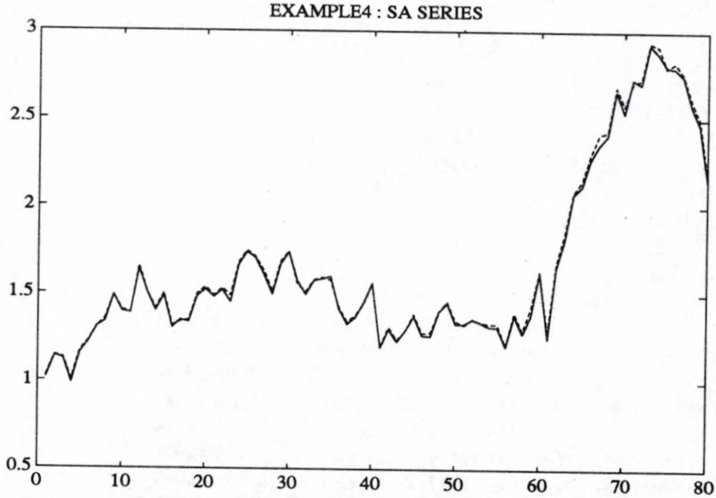
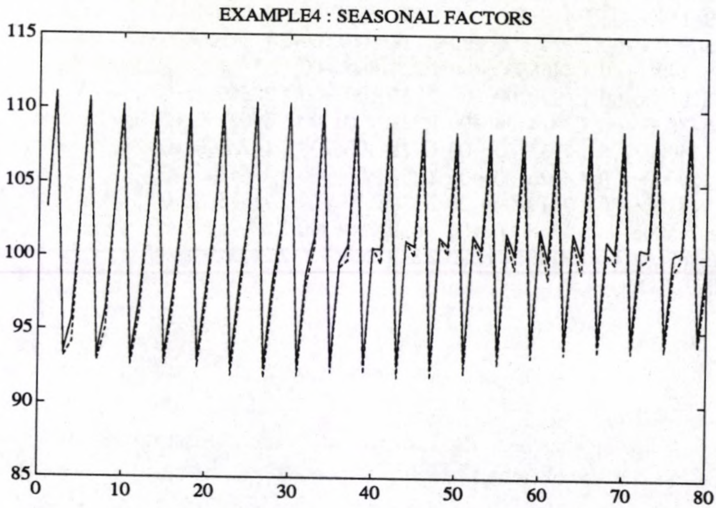
Figure 4: **EXAMPLE4**





5 Appendix: Identification of the Arrays Produced by SEATS

Description of the Files in GRAPH

Meaning	Title of Graph	Name of File

5.1 Series

Meaning	Title of Graph	Name of File
Original series	Original series	*serie.t*
Tansformed series (logs)	Transformed series (logs)	*tserie.t*
Rate of growth of original series	Series: Rate of growth	*rserie.t*
Differenced series	Differenced series	*differ.t*
Seasonally adjusted series	SA series	*seasadjo.t*
Seasonally adjusted series (logs)	SA series (logs)	*seasadjt.t*
Rate of growth of seasonally adjusted series	SA series: rate of growth	*sarate.t*
Seasonal factors (levels)	Seasonal factors	*seasfac.t*
Seasonal component (logs)	Seasonal component	*seas.t*
Trend (level)	Trend	*trendo.t*
Trend component (logs)	Trend component	*trendt.t*
Rate of growth of trend	Trend: Rate of growth	*trate.t*
Cyclical factors (levels)	Cyclical factors	*cyclefac.t*
Cyclical component (logs)	Cyclical component	*cycle.t*
Irregular factors (levels)	Irregular factors	*irregfac.t*
Irregular component (logs)	Irregular component	*irreg.t*
ARIMA residuals	Residuals	*resid.t*
Pseudoinnovations in the components		
Seasonally adjusted series	Pseudo–inn.: SA series	*pisa.t*
Trend	Pseudo–inn.: Trend	*pitrend.t*
Seasonal	Pseudo–inn.: Seasonal	*piseas.t*
Cyclical	Pseudo–inn.: Cycle	*picycle.t*

When TRAMO has been used as a preadjustment program, the directory GRAPH \SERIES also contains the following series:

Meaning	Title of Graph	Name of File
Original uncorrected series (from TRAMO)	Orig. uncorrect. series	*xorig.t*
Preadjustment factors	Preadjustment factors	*paf.t*
Preadjustment component	Preadjustment component	*pac.t*

When $OUT = 2$ (short summary output), the directory GRAPH only contains the files *series.t*, *seasadjo.t*, *trendo.t*, and *irregfac.t*.

(Note: "Factor" refers to a multiplicative decomposition, "component" to an additive one.)

5.2 Autocorrelation Functions of the following series/models

(Note: ST denotes "Stationary Transformation".)

Differenced series	ACF of differenced series	*dauto.t2*
Residuals	ACF of residuals	*autores. t2*
Squared residuals	ACF of sqd residuals	*autosres.t2*
Theoretical component (ST)		
SA series	Comp: ACF of SA series	*acftsadj.t2*
Seasonal	Comp: ACF of seasonal	*acftseas.t2*
Trend	Comp: ACF of trend	*acfttre.t2*
Cycle	Comp: ACF of cycle	*acftcyc.t2*
Theoretical MMSE estimator (ST)		
SA series	E–tor: ACF of SA series	*acfradj.t2*
Seasonal	E–tor: ACF of seasonal	*acfrseas.t2*
Trend	E–tor: ACF of trend	*acfrtre.t2*
Cycle	E–tor: ACF of cycle	*acfrcyc.t2*
Irregular	E–tor: ACF of irregular	*acfrir.t2*
Empirical estimate (ST)		
SA series	E–te: ACF of SA series	*acfesadj.t2*
Seasonal	E–te: ACF of seasonal	*acfeseas.t2*
Trend	E–te: ACF of trend	*acfetre.t2*
Cycle	E–te: ACF of cycle	*acfecyc.t2*
Irregular	E–te: ACF of irregular	*acfeir.t2*

Meaning	Title of Graph	Name of File

5.3 **Spectra** of the following models

Aggregate ARIMA model	Spectrum series	*spect.t3*
Theoretical component		
SA series	Spectrum SA series	*spectsa.t3*
Seasonal component	Spectrum seasonal	*spects.t3*
Trend	Spectrum trend	*spectt.t3*
Cycle	Spectrum cycle	*spectc.t3*
Theoretical MMSE estimator		
SA series	Spectrum SA series est.	*spectesa.t3*
Seasonal component	Spectrum seas. est.	*spectes.t3*
Trend	Spectrum trend est.	*spectet.t3*
Cycle	Spectrum cycle est.	*spectec.t3*
Irregular	Spectrum irreg. est.	*spectei.t3*

5.4 **Filters** for the components

Wiener–Kolmogorov filters (estimator as function of observed series)
(Note: TD denotes "Time Domain"; FD denotes "Frequency Domain".)

SA series (TD)	SA series filter (TD)	*filtadj.t4*
SA series (FD)	SA series filter (FD)	*filtfadj.t4f*
Seasonal component (TD)	Seasonal comp. filter (TD)	*filts.t4*
Seasonal component (FD)	Seasonal comp. filter (FD)	*filtfs.t4f*
Trend (TD)	Trend filter (TD)	*filtt.t4*
Trend (FD)	Trend filter (FD)	*filtft.t4f*
Cyclical component (TD)	Cyclical comp. filter (TD)	*filtc.t4*
Cyclical component (FD)	Cyclical comp. filter (FD)	*filtfc.t4f*
Irregular component (TD)	Irregular comp. filter (TD)	*filti.t4*
Irregular component (FD)	Irregular comp. filter (FD)	*filtfi.t4f*

(Note: Given that the filters are symmetric, only one side of the filter is kept.)

Psi–weights (estimator as function of innovations in observed series)

SA series	Psi–weights: SA series	*psisa.t4*
Seasonal	Psi–weights: seasonal	*psiseas.t4*
Trend	Psi–weights: trend	*psitre.t4*
Cycle	Psi–weights: cycle	*psicyc.t4*

Meaning	Title of Graph	Name of File

(Note: The arrays contain $4MQ + 1$ elements, and are centered around the coefficient for B^0. Thus for the estimation of the component at period t, $2MQ$ weights refer to innovations prior to t, and the last $2MQ$ weights refer to innovations posterior to t.)

5.5 **Forecasts** of the following series

Original series	Forecasts of orig. series	*forx.t5*
Series in logs	Forecasts of series (logs)	*forlx.t5*
Seasonal factors	Forecasts of seasonal factors	*forsf.t5*
Seasonal component	Forecasts of seas. comp.	*forsc.t5*
Trend (level)	Forecasts of trend	*fort.t5*
Trend component	Forecasts of trend comp.	*fortc.t5*
Cyclical factors	Forecasts of cyclical factors	*forcf.t5*
Cyclical component	Forecasts of cyclical comp.	*forcc.t5*
Preadjustment factor or component (when TRAMO has been used as a preadjustment program)	Forecast of preadjustment factor or component	*fdet.t5*

Note: Each array in FORECASTS consists of three consecutive series: first, the lower and upper limits of the 95% probability interval, and then the point estimators. (The three lines displayed in the graphs.) Thus, if there are N elements in the array, the point estimator series consists of the last $N_1 = N/3$ elements. N_1 is always odd, and the center element corresponds to the last observed period. Therefore, of these last N_1 elements, the first $(N_1+1)/2$ are estimates (or observations) of recent periods, and the last $(N_1 - 1)/2$ form the forecast function.

When $L =$ a positive integer, it determines the number of forecasts computed. When $L = -1$ (i.e., when signal extraction is performed), the number of forecasts for the series and components is equal to $\max(2MQ, FH)$, where $FH = 8$ by default; see Section 3.3.

For example, for the default (monthly) model, the length of the array is 147. The last 49 represent the point estimates, of which the first 25 represent past and present values, and the last 24 the two–year–ahead forecast function.

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